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LIGHTING DATA

EDISON LAMP WORKS

OF GENERAL ELECTRIC COMPANY

GENERAL SALES OFFICE

HARRISON, N. J.

Church Lighting



Information compiled by

A. L. POWELL

Lighting Service Department

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Church Lighting

Information Compiled by A. L. Powell
Lighting Service Department

Introductory

The beginnings of religious worship antedate our records, and religion has always been the focal point of a great part of history. The forms have changed and developed through the ages until now we have countless traditions and symbolisms which mingle to give us our impressions of religion. The architect must "feel" and observe these in designing the structure, and the lighting engineer must do his part in carrying out the expressed or implied ideals.



FIG. 1

Day View of an Evangelical Church with a Dark Ceiling Necessitating the Use of Direct Lighting. Multiple unit fixtures containing four 150-watt MAZDA C lamps in deep bowl mirrored glass reflectors are used on centers 15 by 26 feet hung 40 feet above the floor. The reflectors, sockets, etc., are concealed by an art glass casing which is rendered luminous by three 40-watt MAZDA lamps. The downward light is diffused through a glass plate.

In the early days, services were held in the daytime, save in times of necessity, when meetings were held at night and then the flickering campfire or torches served as a means of lighting. Gradually, however, crude buildings were constructed, temporary at first, as was the case with the Jewish tabernacle, but, as the wandering tribes became settled, of more permanent structure. We read of the glories of the Egyptian edifices, of King Solomon's Temple,

and may actually visit the ruins of some of the ancient Greek and Roman places of worship. These, we note, were designed entirely for use during the daytime with open spaces to let in the sunlight. At night, the only glow was from the sacred fire at the altar, although possibly blazing pine embers were set in metal brackets at intervals along the roof supports for use on special occasions.

The Gothic churches of the middle ages had a very low intensity of illumination, but in those days little light was needed, for most of the worshippers were unable to read or else knew the services from memory. These masterpieces of architecture were, however, well lighted to bring out the beauties of the building. By day, light filtered through immense stained glass windows and the beams of colored light, in vivid contrast to the dark woodwork, presented an impressive picture. Very little light was effective in the upper part of the room and the lofty vaulted ceilings seemed still higher. At night, although the light sources, huge clusters of candles, were not far from the floor, and hence often in the line of vision, the brilliancy was so low as to make them relatively unobjectionable. The flickering shadows cast by these units increased the majesty and solemnity of the structure.

Now, however, practically everyone reads and a light suitable for reading is required.

General Requirements of Modern Lighting

No set rules can be laid down for designing church lighting as the structures vary widely in type and the artistic effect plays such an important part. In other words, this class of lighting cannot be standardized as that for the industrial plant, office or store. In attempting to discuss the subject, one can only outline the conditions likely to be encountered and schemes which have proven satisfactory in service.

The illuminating engineer must co-operate with the architect and bear out the latter's ideas with respect to the lighting effect to be attained, and specify such location of units, types of fixture and distributions of light as to meet these criteria. If care is taken in selecting and locating the lighting fixtures, these edifices can be very satisfactorily lighted, for they seldom have brilliant interior finishes to cause glaring reflections; while the ceilings usually are high, thus permitting hanging the lamps out of ordinary view.

Observation of actual installations reveals that, if our homes were as poorly lighted as many of our churches, it would soon have

a serious effect on our vision. As we are in the church for only a few hours every week, the matter is not given sufficient thought.

In the church, in contrast to the theater, or assembly hall, the lights are turned on the entire time that the congregation is present, and particular attention must be paid to the arrangement of lighting units, concealing the lamps from view or equipping them with diffusing glassware.



FIG. 2

Night View of a Small Evangelical Church with a Dark Ceiling. Direct lighting is supplied by 150-watt bowl frosted MAZDA C lamps in dense opal bowl reflectors.

These are spaced on centers 18 by 14 feet symmetrically throughout the room.

The former lighting consisted of inefficient lamps in roughed crystal globes. There were six times as many light sources in the field of view as are now present

As pointed out, the lighting units should be in architectural conformity with the structure, yet utility of the lighting must be given consideration. By this is meant—first, use every precaution to prevent eyestrain, which leads to drowsiness and attendant discomfort; second, provide enough light in all parts of the room for easy reading. Experience has shown that, if there is no annoying glare or bad contrast, an intensity of from 0.75 to 1.5 foot-candles is sufficient for reading at short intervals, as for instance, during the singing of a hymn or psalter responses.

It is impracticable to specify the wattage necessary to obtain the desired illumination or give figures on the utilization constants for the different systems suggested, due to the wide variation in character of surroundings. The illustrations show some typical examples, and these, with the data presented in the bibliographical references, indicate the range of values which have been applied.

Methods to Avoid in Church Lighting

Huge chandeliers, unless very carefully designed, have no architectural significance, and, as ordinarily employed, create severe glare. The tendency seems to be to hang these fixtures too low and use a large number of small lamps. With this arrangement, it is almost impossible to avoid glare, and many a church otherwise pleasing is spoiled by such lighting. In a number of instances, fixtures originally intended for gas jets or low powered lamps have been modified to accommodate the brilliant high efficiency modern lamp and are decidedly objectionable. Where such fixtures are employed, special precautions must be taken to see that the light sources are of low brilliancy.

Studded lights around the capitals of the pillars, along the beams and on the corbels are also objectionable for it is almost impossible to avoid annoying images. While this system sometimes brings out the architectural beauties of the building, it is difficult to maintain, and each burned out lamp will make a break in the continuity and spoil the effect sought. The use of this system will occasionally produce freak effects. For instance, a row of small lamps around the capital of a pillar may give the appearance of an open space and leave the roof and its arches without visible means of support. The efficiency of this system is low and renewal cost high.

Bracket units at the front of the church and decorative lighting around the pulpit and organ are particularly objectionable, for anyone giving attention to the speaker will be looking toward these bright spots. This is one of the most common causes of unsatisfactory church lighting.

Feasible Schemes for Lighting

Churches fall in two distinct groups—the ritualistic and the evangelical. In the former, the sanctuary or altar is the center of attraction and symbolically demands the higher intensity of illu-

mination. In the evangelical church, the speaker, pastor or minister is symbolically the representative of the Divine Power and demands the higher illumination.

The very structures of the buildings devoted to these two groups



FIG. 3

A Combination of Direct and Indirect Illumination is Employed in This Gothic Structure of Light Gray Stone. Deep bowl mirrored glass reflectors are recessed at the crossings of the arches of the main and side aisles. These are the 300 and 200-watt sizes respectively. Smaller inverted units are placed at the capitals and upper corbels for the indirect effect. The power consumption is 1.6 watts per square foot of floor area. Special lighting for the altar is concealed behind the chancel pilasters. As evidenced by this night view, the lighting is comfortable and the distribution very uniform

still further separate their lighting requirements. The ritualistic church is generally of the Gothic type of architecture with the nave and transept forming a cross. A high peaked roof is also characteristic of this form of structure and dark surroundings are likely

to prevail. In the evangelical church, the Basilica type of structure is frequently followed. The ceiling is more likely to be light in color and also flatter. Even where the Gothic style of architecture is employed, it is usually modified and presents less of a lighting problem.

Ritualistic Churches

As mentioned before, in many cases the ceiling is too dark in color to warrant the use of indirect systems of lighting and the nave and transept must be lighted by direct overhead units. The following systems of lighting are applicable to the ritualistic church with dark surroundings; those buildings with light surroundings can be well lighted by the methods discussed under evangelical churches.

A. Direct lighting fixtures consisting of clear MAZDA C lamps and reflectors enclosed in some sort of an ornamental housing. This housing can be made up of art glass and wood, or metal work in the form of a lantern to enclose one or more equipments. (Fig. 1.) The multiple unit fixture offers certain advantages in that the failure of one unit will not leave an entire section in shadow. Mirrored glass reflectors are excellent here, but must be supplemented by a few low wattage lamps inside of the fixture to illuminate the art glass. Translucent, prismatic or dense opal reflectors are also effective and the transmitted light serves the purpose of the small lamps. Such fixtures as these can be relatively large suspended from the peak of the arch or smaller in size dropped from the hammer-beams.*

B. Bowl frosted MAZDA lamps in simple direct lighting opalescent glass reflectors can be suspended from the hammer-beams and form a very inexpensive method of lighting. If possible, a Gothic type of decoration should be secured. This scheme, with a different arrangement, is pictured in Fig. 2. As an alternative to open type reflectors, simple types of enclosing globes of Gothic design can be used in the same position. Opalescent glass, of course, gives good diffusion but the whiteness of the glass shows up in contrast with the background. It is desirable, therefore, to employ units with a spray of light brown or similar color. The slight absorption of the toning is offset by the improved appearance of the installation.**

C. Direct lighting angle or symmetric reflectors, with clear MAZDA lamps, can be placed behind the hammer-beams, sending

* See reference 1 in bibliography.

** See reference 2 in the bibliography.

the light downward. These should be on the side toward the altar, not in the general view of the congregation, and if the proper type of reflector is chosen, they will not be annoying to the speaker.***

D. In the Gothic structure, with light surroundings, a combination of direct and totally indirect lighting is often applied with excellent results, as indicated in Fig. 3. In this building the utilization of light from an indirect system would be of a very low



FIG. 4

The Smooth Light Colored Ceiling of This Auditorium Lends Itself to the Semi-indirect System. 500-watt MAZDA C lamps are used in the four large central units and eight 200-watt units of similar design are placed above the balcony. The neatness of the fixture and harmonious design of the bowls create a most pleasing effect

order due to the great height, in comparison with the width. Direct lighting reflectors are recessed at the crossing of the arches and the indirect units eliminate severe contrasts in brightness.

Evangelical Churches

Since the ceilings of many of these buildings are light in color and nearly flat, there is considerable latitude in the choice of lighting equipment. In contrast to the pure Gothic structure, all three

*** See reference 3 in the bibliography.

systems of illumination—direct, semi-indirect and totally indirect—have their uses. Frequently the architectural features of the building offer certain logical places for the attachment of lighting fixtures, at the crossing of the nave and transept, for example, or at symmetrical points along the main peak. Balance is usually desirable in the location of outlets.

Many forms of direct lighting devices suggest themselves. They should generally be of the enclosed, rather than the open type, as the likelihood of glare is then diminished. Decorated, opalescent glass, parchment, and painted mica are among the materials which can be effectively used for this purpose. A very wide latitude exists in the choice of equipment. The funds available for fixtures will govern this factor. As an example of extreme simplicity, inexpensive enclosing units with clear MAZDA C lamps can be placed at the apex of the arches separating the side aisles from the main aisle in the modified Gothic structure. A sufficient spread of light will be obtained and lighting units will be well out of view.

Semi-indirect units symmetrically spaced are applicable to the church with a light colored ceiling and are available in a wide variety of decorations which will harmonize with the architectural design. Fig. 4 indicates the character of illumination which can be secured when this system is employed.*

Totally indirect illumination can be accomplished in a number of ways. Hanging ceiling fixtures with clear MAZDA C lamps in mirrored glass reflectors concealed by an appropriate decorated housing are inexpensive and simple to install. (Fig. 5.) Smaller lamps in mirrored glass individual or trough reflectors can be located in a cornice or groups of such units placed in recesses at the tops of the columns or capitals. (Fig. 3 and 5.)** Wall boxes with suitably designed mirrored glass reflectors have also been employed for this method of lighting. Occasionally, recessed windows offer logical locations for such equipment. The installation shown in Fig. 6 employs a novel method for indirect illumination. Here deep recessed boxes are used at the front of the balcony, these boxes are so shaped as to confine the light to the ceiling and avoid "spill" light on the walls.***

Many churches are provided with an art glass ceiling to admit natural light. Excellent artificial illumination can be accomplished by properly placing direct lighting reflectors and clear

* See reference 4.

** See reference 5.

*** See reference 6.

MAZDA C lamps above the skylight. The methods discussed in Bulletin Index 39, "The Lighting of Public Buildings," are applicable here. Where the skylight is limited in area it is often necessary to supplement illumination received from this by overhead units placed between it and the side walls. A combination of semi-indirect or totally indirect illumination and the diffused direct light through the sky window proves effective.



FIG. 5

Night View of a Church with Totally Indirect Fixtures of the Luminous Bowl Type. General illumination is furnished by 500-watt MAZDA C lamps in inverted mirrored glass reflectors and 75-watt MAZDA C lamps, in smaller angle units at the capitals. The Baptismal Pool is especially illuminated to a high intensity by concealed units

For balconies, the general overhead lighting of the auditorium will usually take care of the balcony itself. Lighting beneath the balcony can be accomplished by the use of the wall type indirect lighting box previously mentioned, close ceiling hemispheres or flat plates attached to the lower side of the balcony. The glass should be of an opalescent character giving good diffusion with minimum absorption.

In order that the place occupied by the minister or speaker be illuminated to a higher degree than the rest of the church, it is desir-

able to have some means of projecting light on the pulpit. The suspension type spot lamp with concentrated filament MAZDA lamp is compact and can be hidden from view. One of these units located above the speaker will produce the desired result. It should be focused so that a rather widely spread beam, not a sharply defined spot, is obtained.

Choir, guild, and Sunday school rooms present no problems differing from small assembly rooms for other purposes. These are discussed in Bulletin Index 37, "Lighting of Theatres and Auditoriums."

Special Lighting Requirements

Chancel

On account of the desirability of concentrating the attention on the elaborate ritual held in the sanctuary, this must be the most brightly lighted portion of the church, and yet no lights should be visible, for the congregation faces in that direction. In the Gothic structure there is usually an excellent opportunity for locating the units behind the chancel arch. Steel or mirrored glass, angle reflectors simplify the problem remarkably.

The sanctuary should have plenty of light to bring out its decorative value, and yet the altar should not be uniformly bright, for shadow effects are then lost and the elaborately carved portions appear flat and dull, with consequent absence of detail. It is usually better to light the altar from the sides, simulating the daylight values, rather than from the top, to avoid any deep shadows without entirely eliminating them.

The lamps should be so arranged that the choir stalls are well illuminated, and it is often desirable to have the units on several switches, to meet the demands of the different portions of the services.*

In the synagogue, the scroll kept in a cabinet at the rear of the altar should be illuminated by a few low wattage concealed lamps placed to furnish uniform illumination. A switch turning these on automatically as doors are opened is a desirable accessory. An outlet above the altar or a low wattage lamp for the "Light Everlasting" and convenience outlets for the imitation candlesticks on the altar are also necessary features.

Choir Loft

In the evangelical church, this occasionally presents a problem.

See reference 8.

often being located at the front. The light from the main auditorium units is both low in intensity and from the wrong direction.

A practice is often followed of placing a few brackets on the organ and shielding the lamps with some sort of diffusing shade. These units are continually in the vision of the congregation and are extremely annoying. One solution is to place the lamps in

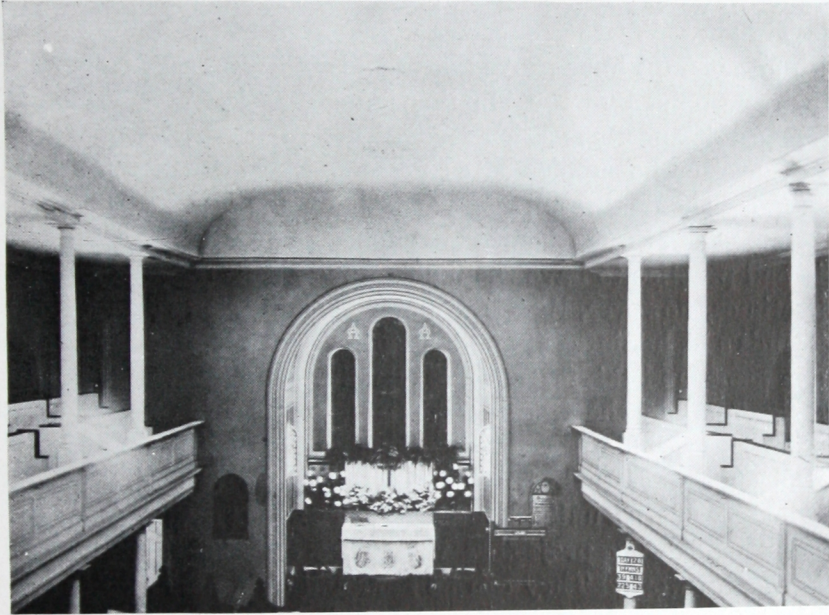


FIG. 6

A Colonial Type Episcopal Church with a Novel Lighting System. Deep boxes are provided in the balcony and 500-watt MAZDA C lamps with suitable reflectors located in these lighting the church by the totally indirect method. No fixtures are visible and lamps are concealed from view. There is nothing to spoil the Georgian simplicity

recessed boxes in the overhanging portion of the organ, and diffuse the light through glass plates. If the organ structure will not permit of this, bowl shaped steel reflectors painted on the outside to harmonize with the organ finish can be used on brackets. While these are not especially decorative, a strong light is provided on the books of the choir, and, as the reflectors are opaque, the eyes of the congregation are protected. Reading lamps on music racks, as in the orchestra pit of a theatre, are also applicable and possess many advantages.

A local lamp is, of course, provided for the organist, and in many instances it is advisable to have a low candle-power lamp below the keyboard to illuminate the pedals. All these lamps

should be separated from the main circuits and be readily controlled for use during rehearsals.

Windows

Most churches have at least one elaborate stained art glass memorial window. By day this is a thing of beauty, but at night, when viewed by reflected rather than transmitted light, it appears as a dark, dull space. In most cases it is not difficult to illuminate the window. Weatherproof type, enameled steel, angle reflectors with clear lamps have proved of use. In most cases it is necessary to make a point by point illumination calculation to determine the type of unit and its location for the even distribution of light, and this can often be supplemented by some slight experimentation to determine the final result.

As a general rule, the window should be evenly illuminated, and it is bad practice to have the light source visible through the glass. Sometimes, however, there is a point in the design which logically demands a higher intensity of light, as for example, the sky in a landscape scene, and this feature must be given attention, as evidenced by Fig. 7, where the figure of the Savior is the most brilliant spot.

For large windows a very effective method is to project from a distance a beam of light having sufficient spread to cover the entire window area with a uniform intensity. There are available weather-proof floodlighting projectors which are especially applicable to this class of work. They can be mounted on a post or other convenient location, from 25 to 300 feet from the window, and the beam trained on to the window and its spread varied as necessary. The 500-watt unit is sufficient to cover 20-foot windows with the unit mounted 100 feet away.*

Clock Tower and Belfry

The translucent face of the clock is frequently illuminated from the rear and will appear spotted unless care is taken in the arrangement of lamps for this purpose. If the interior recess surrounding the face is painted a flat white and maintained in this condition, and diffusing bulb lamps used, the entire area becomes luminous and the face presents a uniform appearance due to the multiple reflections and diffusion thus secured.

In some localities the church is located in such a position that it is visible from considerable distances. A dignified method of having it stand out by night is to illuminate the steeple or belfry

* See reference 9.



FIG. 7

Night View of a Church Window Illuminated by a 500-watt Floodlighting Unit. It is a simple matter to install and maintain such a device

by floodlighting projectors (See Bulletin Index 95). For this system to be effective the object should of course be light in color. For other conditions, for example, where the belfry is open, lamps concealed behind the casements illuminate the interior. It is occasionally the practice to turn such lighting on while services are being held, indicating the fact to the community, as the flags flying over

the north and south wings of the Capitol in Washington show that the Senate or House respectively is in session.

Exterior

In conclusion, it might be well to mention some of the recent innovations along this phase of church lighting. Installations of ornamental street lighting are often made directly about the church and have the effect of attracting attention, with the result that the chance pedestrian is often induced to attend the service.

The modern church is beginning to feel the necessity of advertising. This takes numerous forms. Some churches utilize the local newspapers or bill-boards, buying space in the regular manner; others (somewhat more conservative) apply slightly different means, by having some sort of illuminated sign attached to the church building (Fig. 8) drawing one's attention to the fact that the church is open and everyone welcome. This sign is often in the form of a cross, star or other emblem. Some interesting data on the relative merits of various forms of signs will be found in Bulletin Index 92.*

The progressive church announces the coming events on a bulletin board. If this is illuminated by night, it is especially effective standing out against the darker background, and attracting more attention than it does by day. Two or three low wattage lamps in small weatherproof reflectors serve the purpose at a low operating cost.

Suggestions Regarding Wiring

In many respects the demands of the church are similar to those of the theatre and it is advisable to have a conveniently located central control. Dimmers are an especially desirable feature, both on the main and chancel circuits. During the sermon, the dimming of lights produces an excellent effect.

An experiment with colored lighting is now being carried on in "St. Mark's Church in the Bowurie," New York City. Direct lighting lantern type fixtures are used to produce red, amber, blue and green toned illumination. During the prayer one combination is employed, during the sermon another, at the offertory still another. The psychological effect is taken into consideration at each point, blue green for meditation, red and amber for stimulation and so on. There are undoubtedly wonderful possibilities to this, and the future will see great developments. Such

*See reference 10.

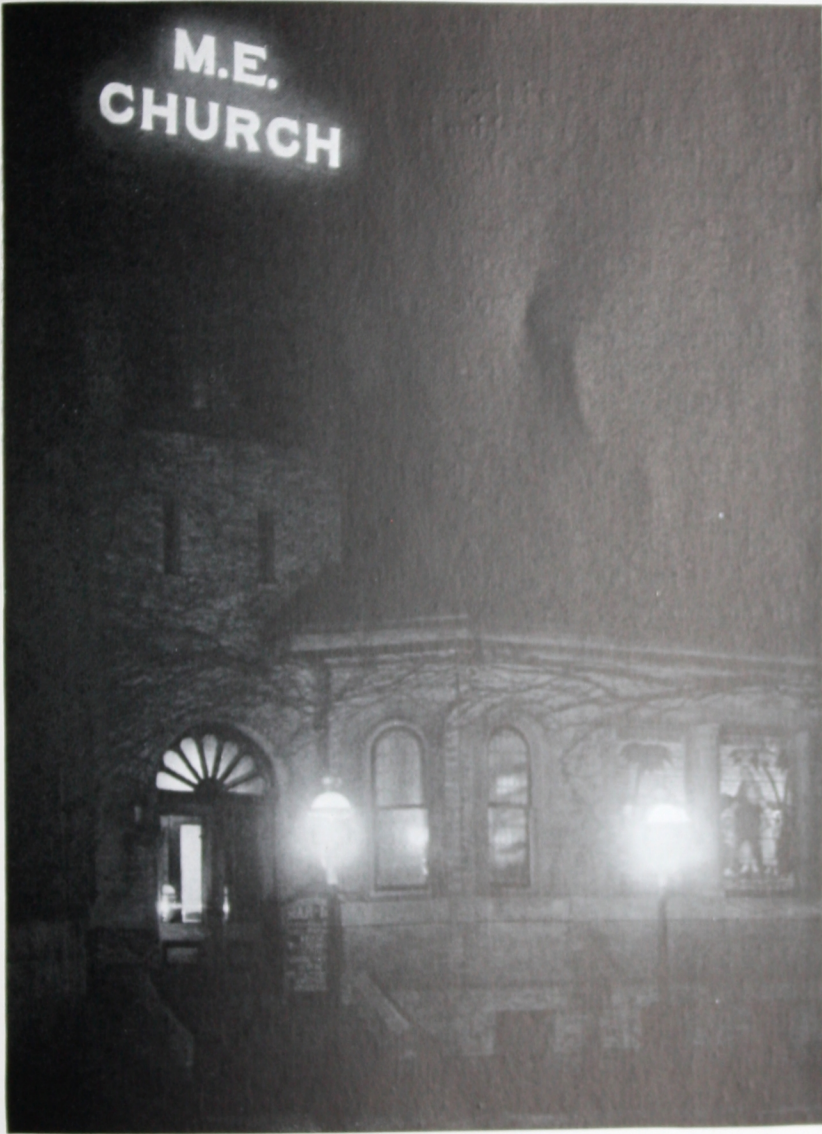


FIG. 8

Ornamental Standards and a Sign on the Belfry Serve to Call This Church to the Attention of the Passerby. Light is always inviting

manipulation of the light requires a number of circuits with the necessary switching and dimming controls.**

Standard convenience outlets at certain points about the building are a necessity. In some churches entertainments are given requiring the use of a stereopticon. A stage pocket at the rear of

**See reference 11.

the auditorium with sufficient capacity for the lantern is a feature worthy of attention.

The moving picture is becoming a factor in church work and a suitable booth for the machine is of course necessary.

Convenience outlets throughout the auditorium make it a simple matter to attach vacuum cleaners.

On various occasions decorative lighting is called into play as, for example, at Christmas time when a tree might be illuminated by small lamps. A receptacle on the rostrum or stage is necessary for such occasions.

Many pastors use notes and a reading lamp providing a strong localized light is often necessary.

In Catholic churches there are certain services and parts of the service which require special lighting effects, and for grand celebrations, as at Easter or Christmas, special decorative effects are brought into play. Adequate capacity in convenience outlets must be provided for these purposes.

In some churches candles have been replaced with imitation candlesticks and all frosted MAZDA candelabra lamps. In most services, however, the candle has a symbolic value which should be retained.

A feature often overlooked in designing a lighting system is the fact that reflectors and lamps become covered with dust which very materially reduces the light output as discussed in Bulletin Index 14, "Maintenance of the Lighting System." In many cases complaints of poor illumination are due to this cause alone. In the church, with its high ceiling, fixtures are very likely to be most inaccessible and the sexton accordingly is hesitant about risking his safety for the sake of cleaning the units. If one wishes the installation to give continuous satisfaction, he should keep the question, "Will it be easy to clean reflectors and replace burned out lamps?" constantly in mind. Equipment should be located so that it is directly accessible or lowering devices provided. Automatic cutout hangers are of assistance here and suitable windlasses for massive fixtures are a necessity.

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*PORTLAND, ORE.....	Electric Building
PROVIDENCE, R. I.....	Turks Head Building
RICHMOND, VA.....	Virginia Railway and Power Building
ROCHESTER, N. Y.....	Granite Building
*SALT LAKE CITY, UTAH.....	Newhouse Building
*SAN FRANCISCO, CAL.....	Rialto Building
SCHENECTADY, N. Y.....	G. E. Works
SEATTLE, WASH.....	Colman Building
SPOKANE, WASH.....	Paulsen Building
SPRINGFIELD, MASS.....	Third National Bank Building
*ST. LOUIS, MO.....	Pierce Building
SYRACUSE, N. Y.....	Onondaga County Savings Bank Building
TACOMA, WASH.....	1117 Pacific Avenue
TERRA HAUTE, IND.....	Terra Haute Trust Building
TOLEDO, OHIO.....	Spitzer Building
TRENTON, N. J.....	Broad Street National Bank Building
WASHINGTON, D. C.....	Commercial National Bank Building
WORCESTER, MASS.....	State Mutual Building
YOUNGSTOWN, OHIO.....	Stambaugh Building
*For Texas, Oklahoma and Arizona business refer to:	
SOUTHWEST GENERAL ELECTRIC COMPANY (formerly Hobson Electric Co.)	
DALLAS, TEXAS.....	Interurban Building
EL PASO, TEXAS.....	206 San Francisco Street
HOUSTON, TEXAS.....	Third and Washington Streets
OKLAHOMA CITY, OKLA.....	1 West Grande Ave.
PHOENIX, ARIZ.....	Heard Building
SAN ANTONIO, TEXAS.....	State National Bank Building

*Stock of lamps at these points

EDISON LAMP FACTORIES

AMPERE, N. J.	FT. WAYNE, IND.	OAKLAND, CAL.
BELLEVILLE, N. J.	HARRISON, N. J.	SCRANTON, PA.
EAST BOSTON, MASS.	NEWARK, N. J.	ST. LOUIS, MO.
	NEW BRUNSWICK, N. J.	